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DRILLING DEVICE FOR FORMING DEEP WELLS IN SOIL, ROCK, ETC.

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Claims

1. Drilling device for forming wells, particularly deep wells, in soil, rock, etc., characterized by the fact that rotary, advancing, and percussion drilling equipment is arranged directly behind the known drilling bit and respective drilling head, wherein the drilling device 8 is supported on the well wall 1.

2. Drilling device for forming wells, particularly deep wells, in soil, rock, etc., according to Claim 1, characterized by the fact that a drilling head rinsing device is provided, wherein rinsing fluid is introduced into the drilling head cavity (11) via an inner pipe (12) and transported away together with the loosened material through an outer pipe (13) and the respective annular space formed between both pipes, and wherein the pipes (12 and 13) extend through the rotary and percussion equipment (7) and the feeding equipment (8).

3. Drilling device for forming wells, particularly deep wells, in soil, rock etc., according to Claims 1 and 2, characterized by the fact that the rotary and percussion equipment (7) is mounted on the drilling head (6), wherein the rotary drive is realized hydraulically for example, with a radial piston motor.

4. Drilling device for forming wells, particularly deep wells, in soil, rock, etc., according to Claims 1 and 2, characterized by the fact that the rotary equipment (7) is operated hydraulically by means of one or more axial piston motors and corresponding equipment.

5. Drilling device for forming wells, particularly deep wells, in soil, rock, etc. according to Claims 1 and 2, characterized by the fact that the rotary equipment (7) is operated by means of an electric motor with a gear assembly.

6. Drilling device for forming wells, particularly deep wells in soil, rock, etc. according to Claims 1 and 2 and the corresponding subsequent claims, characterized by the fact that the feeding equipment (8) contains a crawler or chain drive (14 + 21).

7. Drilling device according to Claim 6, characterized by the fact that the crawler or chain drive (14) can be adjusted radially relative to the well by means of rod assemblies (15) and cylinders (16), such that the respective drive can be pressed against the well wall.

8. Drilling device according to Claims 6 and 7, characterized by the fact that the adjusting devices (16) consist of hydraulic cylinders.

9. Drilling device according to Claims 6 and 7, characterized by the fact that the adjusting equipment (16) consists of pneumatic cylinders.

10. Drilling device according to Claims 6 and 7, characterized by the fact that the rod assemblies (15) for pressing the chain drives (14) against the well wall are operated electrically by means of an electric motor, a gear assembly and a spindle.

11. Device according to Claims 1 and 2 and the corresponding subsequent claims, characterized by the fact that pressing rollers (18) are provided between the driven chain reversing wheels (21).

12. Drilling device according to Claims 1 and 2 and the corresponding subsequent claims, characterized by the fact that the feeding equipment (8) is driven by means of profiled wheels, rollers or cylinders that can be pressed against the well wall (1) and the running surface of which may be adapted to the curvature of the well wall.

13. Drilling device according to Claims 1 and 2 and the corresponding subsequent claims, characterized by the fact that the pipe sections (4) consist of a light material, in particular, a (glass fiber-reinforced) thermoplastic material.

14. Device according to Claims 1 and 2 and the corresponding subsequent claims, characterized by the fact that the device for introducing the rinsing fluid and the device for transporting away the loosened material consist of flexible pipes or hoses (9).

15. Drilling device according to Claims 1 and 2 and the corresponding subsequent claims, characterized by the fact that a feed pump for the loosened material and the rinsing fluid is

provided, wherein the feed pump is arranged in the vicinity of the rotary and percussion equipment (7).

16. Drilling device according to Claim 1, 2 and the corresponding subsequent claims, particularly Claim 14, characterized by the fact that transporting or driving devices (10) are provided in order to move long sections of flexible pipe material (9) in and out of the well (1).

17. Drilling device according to Claim 1 and the corresponding subsequent claims, characterized by the fact that the drilling head is also designed for reverse drilling and provided with a drilling bit on its rear side such that the device is able to loosen possibly caved-in material when it is removed from the well.

The invention pertains to a device for drilling deep wells in soil, rock, etc., wherein a rotary drive for the drilling bit and feeding equipment for the drilling bit are arranged directly behind a known drilling head and respective drilling bit, and wherein pipes, hoses, etc. for transporting away the loosened material extend upward from the rotary drive and the feeding equipment.

Deep wells for the exploration and extraction of mineral resources, in particular, natural gas and crude oil, frequently must be drilled over distances of several thousand meters. This is usually realized with a tubular drilling rod assembly, on the lower end of which a drilling head and the respective drilling bit is arranged. The drilling rod assembly is set in rotation, wherein the drive for turning and advancing the drilling rod assembly and hence the drilling head is arranged aboveground. In order to transmit the drilling torque from the driving machine arranged aboveground to the drilling head, it is necessary to use a drilling rod assembly that is able to withstand the torque. Since the torque can become very high at corresponding drilling depths (friction), correspondingly strong drilling rod assembly pipes of metal must be used. These pipes are also heavy and must be flanged together section by section. When the drilling head is worn out and must be replaced, it is particularly complicated to remove the drilling head from the well since the drilling rod assembly must be pulled up section by section and each section must be individually detached and stored. The flange connections must be suitably strong for transmitting the drilling torque. The separation and reconnection of these flanges is time-consuming.

The drilling head drive must be deactivated for the entire time required to replace the drilling head and to extend or shorten the drilling rod assembly.

The loosened material is collected in the hollow space of the drilling rod assembly. The full weight of the loosened material acts downward in the direction of the drilling head and thus contributes significantly to the wear on the drilling head.

In addition, the drilling machine arranged aboveground is very complex and powerful as it must be able to generate the aforementioned high torque.

The invention is based on the objective of proposing a device for drilling deep wells in soil, rock, etc. which allows a significantly simpler and faster operation.

The drilling device is characterized by a drilling head drive (advancement + rotation + percussion) that is arranged directly behind the drilling tool or the drilling bit. Thus, a drilling rod assembly in the previously described sense which must transmit high torque is no longer required. In principle, it is possible to utilize lightweight pipes, e.g., of a thermoplastic material. These lighter pipes can be handled more easily, and the individual pipe sections thus can be replaced and adapted to the given depth of the well relatively quickly.

The drilling machine aboveground can also be eliminated; in this case, the feeding and rotation of the drill bit is realized with self-driving feeding equipment. This feeding equipment is supported on the well edge and can be pressed against this well edge with its drive elements.

In addition, the well is rinsed so that loosened soil and rock can be continuously transported away. This significantly increases the service life of the drilling head. The rinsing and the removal of the loosened material takes place directly through the described drives.

The downtime can be significantly reduced with this arrangement. During the drilling process, it is merely required to connect non-rotating pipe sections for transporting away the loosened material. This only requires an insignificant interruption in the drilling process. The rinsing and the removal of the loosened material may also be briefly stopped for the duration required for connecting a pipe section. The time savings are significant, particularly if a worn out drilling head that is located at a depth of two thousand meters is to be replaced. Conventional pipe sections have a length of approximately 10 m, i.e., a total of 200 pipe sections that must be raised, detached and stored would be required in this case. After the drilling head is replaced, the process is reversed and the pipe sections are reattached in the same sequence. It is quite obvious that this causes the loss of many workdays.

The invention eliminates these disadvantages. The drilling head drive according to the invention may simultaneously serve as the drive for removal of the pipes for transporting away the loosened material. The drilling head drive practically climbs continuously out of the well so that the pipe sections can be continuously detached aboveground. Since the pipes consist of a lighter material, it is also possible to use significantly longer pipe sections, e.g., up to 50 m. This would reduce the time required for lowering the new drill into the existing well fivefold.

In addition, it is also possible to use hoses instead of pipes for transporting away the loosened material, wherein said hoses are so flexible that they can be guided over a reel

aboveground. In this case, the drilling head can be continuously removed from the well together with the feeding equipment according to the invention or other auxiliary means.

In this case, the drilling head would also be able to move downward continuously into the well when drilling deep wells.

Naturally, it is also possible to operate the drilling device according to the invention with conventional drilling rod assembly pipes, particularly if high transport pressures are expected.

Embodiments of the invention are illustrated in the figures and described below, wherein the scope of protection of the invention is not limited to these embodiments.

The figures show:

Figure 1, a schematic representation of a deep well being drilled, wherein the pipes for transporting away the loosened material consist of pipe sections;

Figure 2, a schematic representation of a system for drilling deep wells according to the invention, wherein the device for transporting away the loosened material consists of a flexible hose;

Figure 3, the drilling device in partial longitudinal section;

Figure 4, a detail of the drilling device, viz., the feeding equipment, and

Figure 5, a top view of the feeding equipment according to Figure 4.

Figure 1 shows a well being drilled. A drilling rig 3 is arranged above the ground 2 in order to attach pipe sections 4 for transporting away the loosened material and supply lines. The connections between the individual pipe sections are conventionally realized in the form of flange connections 5. The drilling device according to the invention is arranged at the base of the well 1 and consists of a known drilling tool or drilling bit 6, a rotary drive 7 that preferably contains percussion drilling equipment for the drilling bit and the feeding equipment 8. Thus, the drilling bit 6 is turned by the rotary drive 7 at the bottom of the well 1. Consequently, the drilling rig 3 no longer requires a rotary drive. It is also possible to connect additional pipe sections 4 in the continuous drilling mode, i.e., the drilling bit 6 continues to operate while the pipe sections are connected. This eliminates downtime. As the pipe sections 4 move downward into the well, new pipe sections are simply attached aboveground. The removal of the pipe sections 4 in the reverse sequence is correspondingly simple if the drilling bit 6 must be replaced. The feeding equipment 8 may simultaneously serve as the device for transporting the pipe sections 4 out of the well so that the pipe sections 4 practically can also be continuously detached on the drilling rig 3.

Figure 2 shows an embodiment variant in which flexible hoses 9 are used instead of rigid pipe sections 4. These hoses can be introduced and withdrawn by means of a device 10. The

feeding equipment 8 may assist in or even entirely effect the removal of the drilling bit 6 from the well. The device 9 for transporting away loosened material also does not turn while drilling in this case.

One embodiment of the drilling head according to the invention is illustrated in Figure 3 in a partially schematic fashion. Reference numeral 6 designates a crown bit e.g., with an internal cavity 11. A rotary drive 7 is connected to this drilling bit 6, wherein the rotary drive drives the drilling bit 6 in a drilling and rotary fashion, e.g., by means of hydraulic drive elements.

A dual pipe 12; 13 extends through this rotary drive 7. The inner pipe 12 may serve for supplying rinsing fluid. The outer pipe 13 serves for transporting away loosened material and for mounting and holding the rotary drive 7 and the feeding equipment 8. This stable dual pipe end at the first flange connection 5 above the feeding equipment 8. Pipe sections 4 that are also realized in the form of dual pipes (inner pipe 4b and outer pipe 4a) extend upward from this first flange connection. The inner pipe 4b may be relatively thin and need not be held centrally in the outer pipe 4a. If a central arrangement is chosen, a few thin connecting webs suffice for holding the pipes relative to one another. In eccentric arrangements of the inner pipe 4b in the outer pipe 4a, the inner pipe is preferably fixed on the inner surface of 4a. It may even be unnecessary to provide such a continuous rinsing line 4b, depending on the type of ground to be drilled. It would also be conceivable to provide a pump for removal of the loosened material in the vicinity of the drilling bit and constantly to maintain the well under water in order to liquefy the loosened material.

In this embodiment, the feeding equipment 8 consists, for example, of chain drives 14, wherein three or four chain drives are arranged on the circumference of the pipe 13. Figures 4 and 5 show that the chain drives can be radially adjusted relative to the well (double arrows 17) by means of rod assemblies 15 and cylinders 16 such that the chain drives can be pressed against the well 1.

It is also possible to provide support rollers 18 in order to ensure the contact between the well wall and the chain 14 over the entire effective length. Naturally, individual profiled driving wheels may also be used instead of the chains 14.

Figure 5 is a top view of Figure 4. Shown are the large cross sections 19 between the inner pipe and the outer pipe 12 and 13. These two pipes may, e.g., be separated and fixed (connecting pieces 20).

The rotary drive for the chain wheels 21 is not shown in order not to complicate unnecessarily the figures.

The invention is not limited to the embodiments shown. As mentioned above, it would

also be possible, e.g., to provide a pump for transporting away the loosened material.

The rotary drive 7 may be realized hydraulically, pneumatically or electrically. Radial piston motors can be advantageously used in hydraulic embodiments. However, it would, of course, also be possible to utilize axial piston motors that operate via gear assemblies.

As mentioned above, a percussion drilling drive may also be provided at 7.

In order to prevent soil, sand, etc. from caving in the well, the well may be conventionally lined by inserting lining pipes that may also consist, e.g., of a thermoplastic material.

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Fig. 1

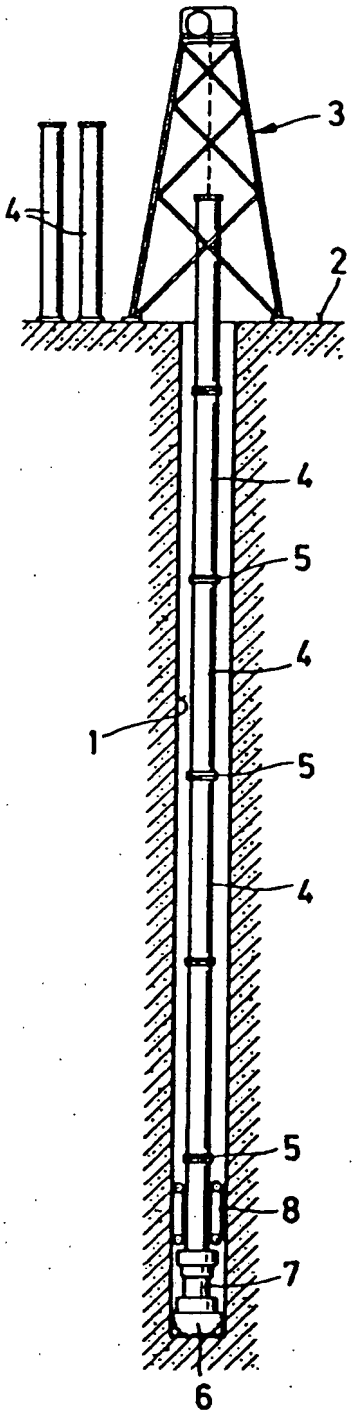

Fig. 2

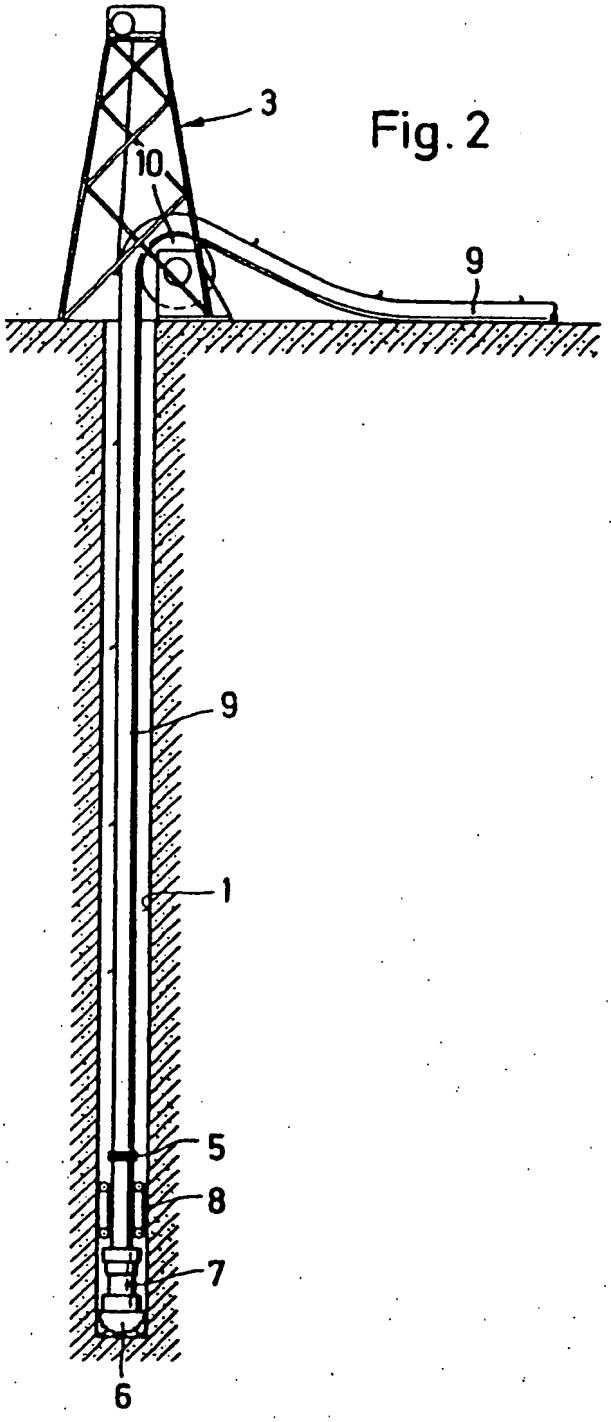

Fig. 3

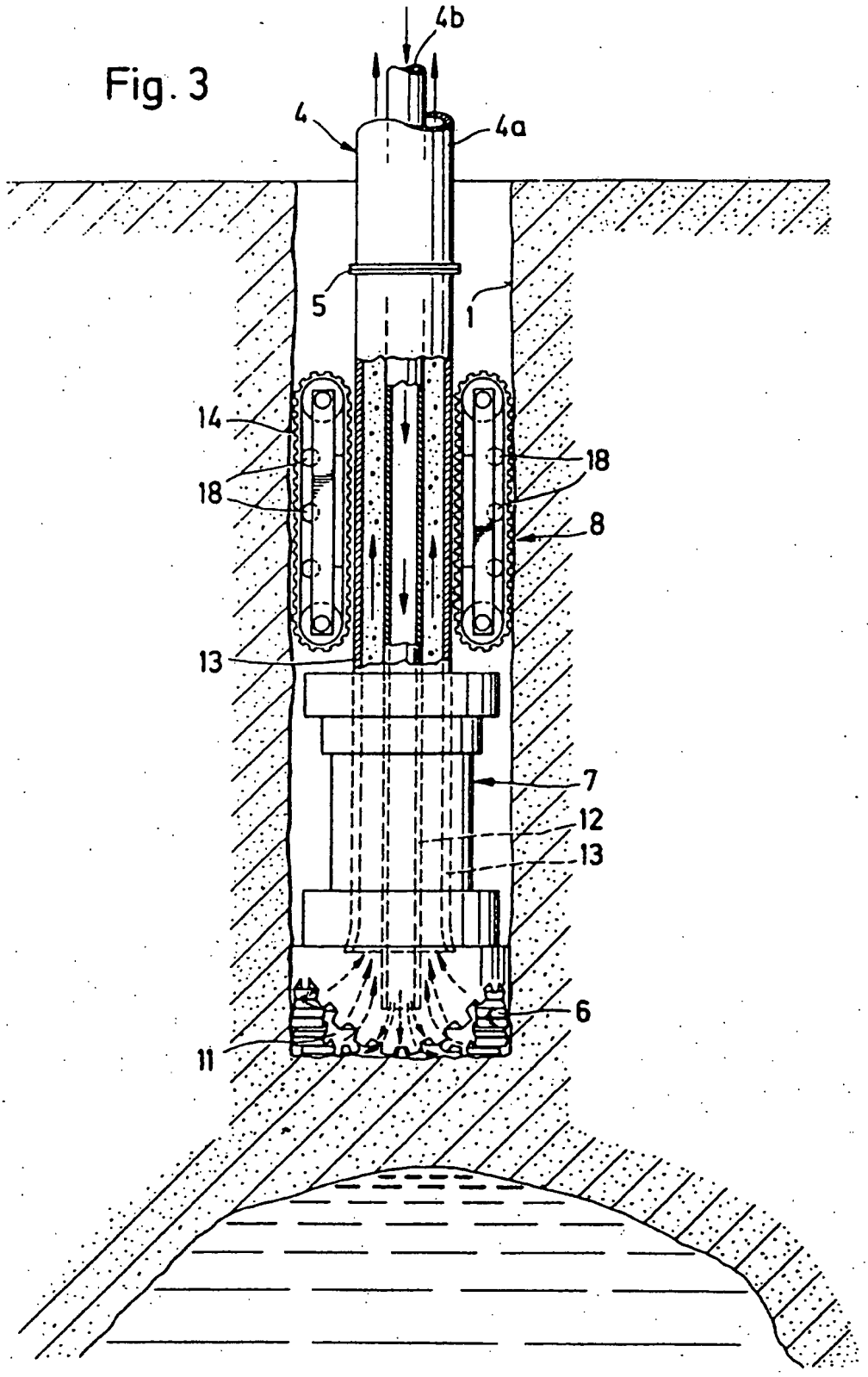

Fig. 4

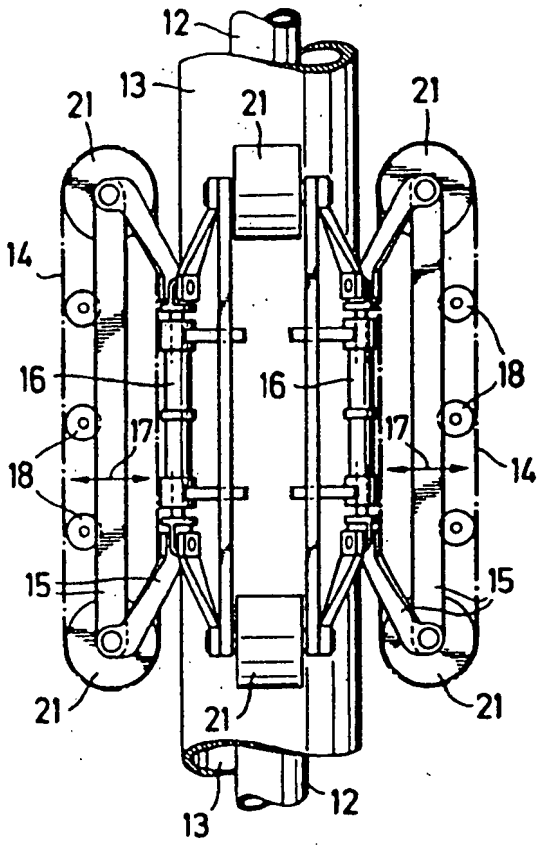

Fig. 5